

Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously Presented) An automated simulation method for determining enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the Dirac coulombic tunnelling integral, comprising the steps of:

assigning the variable C to the ratio of the Poole-Frenkel barrier lowering energy (ΔE_{fp}) divided by the energy range for which tunnelling can occur (ΔE_n);

assigning the value $(C+1)/2$ to a variable v and performing a second order Taylor's series expansion of the Dirac coulombic tunnelling integral around v to determine a maximum value (u_{max}) for the variable u of the integral;

determining if the value for u_{max} is less than C, is between C and 1 or is more than 1;

assigning the value of C to the variable v if u_{max} is less than C;

assigning the value of u_{max} to the variable v if u_{max} is between C and 1;

assigning the value of 1 to the variable v if u_{max} is more than 1;

reducing the Taylor's series expansion of the Dirac coulombic tunnelling integral to an error function;

reducing the error function to simple exponential functions by applying rational approximations to the error function; and

calculating the enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the said simple exponential functions;

wherein said method determines the leakage current in a polysilicon Thin Film Transistor.

2. (Currently Amended) An automated simulation method which determines enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the approximated tunnelling equation set out as ~~equation 26 hereinbelow~~:

$$\int_{t_l}^{t_u} e^{-t^2} dt = \frac{\sqrt{\pi}}{2} [\operatorname{erf}(t_u) - \operatorname{erf}(t_l)].$$

wherein said method determines the leakage current in a polysilicon Thin Film Transistor.

3. (Currently Amended) An automated simulation method which determines enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the approximated tunnelling equation set out as ~~equation 27 hereinbelow~~:

$$\operatorname{erf}(x) = 1 - (a_1t + a_2t^2 + a_3t^3 + a_4t^4 + a_5t^5)e^{-x^2},$$

$$t = \frac{1}{1+px},$$

$$\begin{aligned} a_1 &= 0.254829592; \\ a_2 &= -0.284496736; \\ a_3 &= 1.421413741; \\ a_4 &= -1.453152027; \\ a_5 &= 1.061405429; \\ p &= 0.3275911; \end{aligned}$$

wherein said method determines the leakage current in a polysilicon Thin Film Transistor.

4. (Canceled)

5. (Previously Presented) A simulator for determining enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the Dirac coulombic tunnelling integral, comprising:

means storing a variable C having a value equal to the ratio of the Poole-Frenkel barrier lowering energy (ΔE_{fp}) divided by the energy range for which tunnelling can occur (ΔE_n);

means which assign the value $(C+1)/2$ to a variable v and perform a second order Taylor's series expansion of the Dirac coulombic tunnelling integral around v to determine a maximum value (u_{max}) for the variable u of the integral;

means which determine if the value for u_{max} is less than C, is between C and 1 or is more than 1;

means which assign the value of C to the variable v if u_{max} is less than C;

means which assign the value of u_{max} to the variable v if u_{max} is between C and 1;

means which assign the value of 1 to the variable v if u_{max} is more than 1;

means storing simple exponential functions derived from applying rational approximations to an error function obtained by reducing the Taylor's series expansion of the Dirac coulombic tunnelling integral; and

means which calculate the enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device using the said simple exponential functions;

wherein said simulator determines the leakage current in a polysilicon Thin Film Transistor.

6. (Currently Amended) A simulator which determines enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device comprising means which calculate the approximated tunnelling equation set out as equation 26 hereinbelow:

$$\Gamma_n^{Coul} = \frac{A}{2\sqrt{AI}} \left(\frac{a_1}{(1+pt_l)^2} + \frac{a_2}{(1+pt_l)^3} + \frac{a_3}{(1+pt_l)^4} + \frac{a_4}{(1+pt_l)^5} + \frac{a_5}{(1+pt_l)^6} \right) \exp(-C^2AI - CAII - AIII) \\ - \frac{A}{2\sqrt{AI}} \left(\frac{a_1}{(1+pt_u)^2} + \frac{a_2}{(1+pt_u)^3} + \frac{a_3}{(1+pt_u)^4} + \frac{a_4}{(1+pt_u)^5} + \frac{a_5}{(1+pt_u)^6} \right) \exp(-AI - AII - AIII)$$

$$AI = -\frac{f''(v)}{2}, AII = -[f'(v) - vf''(v)], AIII = -\left[v^2 \frac{f''(v)}{2} - vf'(v) + f(v)\right],$$

$$t_l = \sqrt{AI} \left(C + \frac{AII}{2AI} \right), t_u = \sqrt{AI} \left(1 + \frac{AII}{2AI} \right),$$

$$f(v) = Av - Bv^{\frac{3}{2}} + Dv^{-\frac{1}{6}},$$

$$f'(v) = A - \frac{3}{2}Bv^{\frac{1}{2}} - \frac{1}{6}Dv^{-\frac{7}{6}},$$

$$f''(v) = -\frac{3}{4}Bv^{-\frac{1}{2}} + \frac{7}{36}Dv^{-\frac{13}{6}},$$

$$A = \frac{\Delta E_n}{kT}, B = K_n, C = \frac{\Delta E_{fp}}{\Delta E_n}, D = BC^{\frac{5}{3}}.$$

$v = C$ (for $u_{max} < C$, case 1),
 $v = u_{max}$ (for $C < u_{max} < I$, case 2),
 $v = I$ (for $u_{max} \geq I$, case 3),

$$u_{max} = \frac{f'(v) - vf''(v)}{f''(v)} \text{ for } v = \frac{C+1}{2}.$$

wherein said simulator determines the leakage current in a polysilicon Thin Film Transistor.

7. (Currently Amended) A simulator which determines enhanced generation recombination rate due to trap-to-band tunnelling in a semiconductor device comprising means which calculate the approximated tunnelling equation set out as ~~equation 27~~ hereinbelow:

$$\begin{aligned}
 \Gamma_n^{Coul} = & \frac{A}{2\sqrt{AI}} \left(\frac{a_1}{(1+pt_l)} + \frac{a_2}{(1+pt_l)^2} + \frac{a_3}{(1+pt_l)^3} + \frac{a_4}{(1+pt_l)^4} + \frac{a_5}{(1+pt_l)^5} \right) \exp(-C^2AI - CAII - AIII) \\
 & - \frac{A}{2\sqrt{AI}} \left(\frac{a_1}{(1+pt_u)} + \frac{a_2}{(1+pt_u)^2} + \frac{a_3}{(1+pt_u)^3} + \frac{a_4}{(1+pt_u)^4} + \frac{a_5}{(1+pt_u)^5} \right) \exp(-AI - AII - AIII) \\
 & \pm \frac{A}{2\sqrt{AI}} \exp\left(-AIII + \frac{AII^2}{4AI}\right)
 \end{aligned}$$

wherein said simulator determines the leakage current in a polysilicon Thin Film Transistor.

8.-18. (Canceled)

19. (Currently Amended) ~~The method of claim 1, comprising A method of manufacturing a semiconductor device based on the leakage current. current estimated by the method according to claim 1.~~

20. (Currently Amended) ~~The method of claim 2, comprising A method of manufacturing a semiconductor device based on the leakage current. current estimated by the method according to claim 2.~~

21. (Currently Amended) ~~The method of claim 3, comprising A method of manufacturing a semiconductor device based on the leakage current. current estimated by the method according to claim 3.~~

22.-24. (Canceled)